TECHNICAL SUPPORT DOCUMENT
FOR ON-ROAD MOBILE SOURCES:
PM2.5 EMISSIONS INVENTORY
FOR PM2.5 SIP 2010 BASELINE YEAR
AND PROJECTION YEAR 2015

Winter Weekday and Winter Weekend Days

September 2014
Utah Division of Air Quality
Planning Branch/Mobile Sources

Abstract

This report discusses the on-road mobile source section of the PM2.5 SIP 2010 baseline inventory ("Baseline Inventory") and projection year inventory for 2015 for the domain comprising seventeen counties around the Wasatch Front in Utah.

The on-road mobile source baseline and projection year inventories were developed for a winter weekday and a winter weekend day based on temperatures recorded during the coldest PM2.5 episode studied, which took place from Thursday, January 11 through Sunday, January 21, 2007 inclusive.

Vehicle miles traveled (VMT) on winter weekday and winter weekend days are very different. In general, weekend traffic is lower than weekday traffic in each of the seventeen counties in the PM2.5 SIP domain.

VMT for the counties modeled by the Metropolitan Planning Organizations (MPOs) were produced from their respective Travel Demand Models. Wasatch Front Regional Council (WFRC) agreed to model Box Elder and Tooele Counties in addition to Davis, Salt Lake and Weber Counties.

VMT for the remaining (largely rural) counties in the domain was obtained from Utah Department of Transportation Highway Performance Management System. VMT in units of AADT were projected to 2019 from linear regressions of baseline AADT VMT from calendar years 1996 - 2009.

For these counties, VMT factors for the month of January and for weekday and weekend days were provided by Utah Department of Transportation, Division of Systems Planning and Programming/ Traffic Statistics. Factors were provided for six major road types: rural freeway/interstate, rural arterial, rural local roads, urban freeway/interstate, urban arterial and urban local roads.

Summary tables of inventories for winter weekdays in 2010 and 2015 are found at the beginning of the next section.

On-road inventories were computed using the EPA MOVES2010a (Motor Vehicle Emission Simulator) released August 2010. PM2.5 fugitive dust from paved roads was compiled using AP-42 Chapter 13.2.1, "Introduction to Fugitive Dust Sources, section 13.2.1, "Paved Roads" (published in Federal Register on Feb. 4, 2011).

iv. PM2.5 SIP On-road Mobile Sources Inventory for 17 Counties in Domain
2010 Winter Weekday Emissions (Tons per Winter Weekday)

Year	FIPS	County	NH3	NOx	Total_PM10	Total_PM25	SO2	VOC	VOC Refueling	PM10 Dust	PM25 Dust	Distance
2010	49007	Carbon	0.03	2.70	0.17	0.14	0.01	1.29	0.06	0.59	0.15	774,658
2010	49013	Duchesne	0.02	2.12	0.14	0.12	0.01	1.09	0.04	0.38	0.09	552,164
2010	49015	Emery	0.04	3.67	0.17	0.15	0.02	0.80	0.06	0.44	0.11	833,705
2010	49023	Juab	0.04	3.48	0.16	0.14	0.02	0.75	0.07	0.24	0.06	994,932
2010	49027	Millard	0.05	4.29	0.20	0.18	0.02	0.96	0.08	0.40	0.10	1,099,491
2010	49029	Morgan	0.01	1.12	0.07	0.06	0.01	0.54	0.02	0.10	0.03	337,919
2010	49033	Rich	0.01	0.27	0.04	0.03	0.00	0.21	0.01	0.04	0.01	120,348
2010	49039	Sanpete	0.03	1.78	0.13	0.11	0.01	1.36	0.05	0.32	0.08	550,433
2010	49043	Summit	0.07	6.99	0.36	0.31	0.04	2.24	0.11	0.79	0.20	1,954,205
2010	49051	Wasatch	0.03	2.47	0.17	0.14	0.01	1.25	0.05	0.41	0.10	765,873
2010	49003	Box Elder	0.12	8.86	0.49	0.42	0.04	2.99	0.16	0.71	0.18	2,603,591
2010	49011	Davis	0.33	16.83	1.23	1.00	0.11	10.47	0.48	1.60	0.40	7,561,284
2010	49035	Salt Lake	1.09	51.01	4.06	3.20	0.35	34.85	1.61	5.86	1.46	25,349,568
2010	49045	Tooele	0.11	10.02	0.60	0.49	0.05	3.59	0.20	1.55	0.39	2,474,433
2010	49057	Weber	0.20	12.91	0.93	0.75	0.08	7.83	0.35	1.18	0.29	4,622,292
2010	49049	Utah	0.44	25.39	1.82	1.47	0.16	14.93	0.69	2.91	0.73	10,620,608
2010	49005	Cache	0.12	6.48	0.51	0.40	0.04	4.78	0.21	1.07	0.27	2,750,403

iv. PM2.5 SIP On-road Mobile Sources Inventory for 17 Counties in Domain
2015 Winter Weekday Emissions (Tons per Winter Weekday)

Year	County		NH3	NOx	Total_PM10	Total_PM25	SO2	VOC	VOC Refueling	PM10 Dust	PM25 Dust	Distance
2015	49007	Carbon	0.03	1.75	0.09	0.09	0.01	0.90	0.04	0.62	0.12	792,348
2015	49013	Duchesne	0.02	1.47	0.08	0.08	0.01	0.77	0.03	0.42	0.09	609,668
2015	49015	Emery	0.03	2.26	0.09	0.09	0.01	0.55	0.04	0.46	0.10	864,147
2015	49023	Juab	0.04	2.26	0.09	0.09	0.01	0.52	0.04	0.25	0.06	1,090,420
2015	49027	Millard	0.04	2.75	0.11	0.11	0.01	0.67	0.05	0.44	0.09	1,179,489
2015	49029	Morgan	0.01	0.74	0.04	0.04	0.00	0.38	0.01	0.12	0.03	373,311
2015	49033	Rich	0.00	0.19	0.02	0.02	0.00	0.16	0.00	0.05	0.01	129,196
2015	49039	Sanpete	0.02	1.20	0.07	0.07	0.01	0.98	0.03	0.33	0.07	564,029
2015	49043	Summit	0.06	4.63	0.22	0.22	0.02	1.51	0.08	0.93	0.18	2,214,560
2015	49051	Wasatch	0.03	1.76	0.10	0.10	0.01	0.88	0.04	0.47	0.09	868,732
2015	49003	Box Elder	0.10	6.99	0.33	0.33	0.05	2.35	0.13	0.83	0.14	2,962,478
2015	49011	Davis	0.28	13.07	0.86	0.88	0.13	7.89	0.33	1.96	0.32	8,665,889
2015	49035	Salt Lake	0.93	40.68	2.72	2.81	0.40	25.96	1.07	6.66	1.10	28,969,516
2015	49045	Tooele	0.10	6.56	0.35	0.36	0.05	3.01	0.15	1.87	0.31	2,822,473
2015	49057	Weber	0.18	10.30	0.64	0.66	0.09	6.20	0.24	1.33	0.22	5,327,845
2015	49049	Utah	0.45	21.48	1.34	1.38	0.16	12.60	0.51	3.95	0.66	14,511,851
2015	49005	Cache	0.10	4.49	0.31	0.28	0.03	3.23	0.13	1.28	0.23	3,237,662

3e.iii ON-ROAD MOBILE SOURCES

vii. Overview

The purpose of this document is to explain how EPA MOVES2010a (Motor Vehicle Emission Simulator) released in August 2010 was used to create the PM2.5 SIP on-road mobile source base year (2010) and projection year (2015) motor vehicle emission inventories.

The "baseline inventory" covered winter weekdays and winter weekend days in 2010, based on temperatures recorded during the coldest PM2.5 episode studied, which took place from Thursday, January 11 through Sunday, January 21, 2007 inclusive.

The baseline inventory covers seventeen counties which are part of the PM2.5 SIP domain along the Wasatch Front in Utah. Five of these counties fall under the jurisdiction of a Metropolitan Planning Organization (MPO). Cache County was modeled by Cache MPO, Utah County was modeled by Mountainlands Association of Governments (MAG), and Weber, Davis, and Salt Lake Counties were modeled by Wasatch Front Regional Council (WFRC). In addition, WFRC modeled Box Elder and Tooele Counties because they are part of the Salt Lake PM2.5 non-attainment area and are associated with the WFRC area. The Utah Division of Air Quality (UDAQ) developed inventories for the remaining ten counties in the domain.

No.	County	FIPs	No.	County	FIPs
1	Box Elder	49003	10	Rich	49033
2	Cache	49005	11	Salt Lake	49035
3	Carbon	49007	12	Sanpete	49039
4	Davis	49011	13	Summit	49043
5	Duchesne	49013	14	Tooele	49045
6	Emery	49015	15	Utah	49049
7	Juab	49023	16	Wasatch	49051
8	Millard	49027	17	Weber	49057
9	Morgan	49029			

Projection year inventories were created using the same method used to create the base year inventory. Emissions units for the baseline and projection year inventories were tons per winter weekday and tons per winter weekend day.

Meteorology - For the baseline and projection year inventories, modeled temperatures were taken from the coldest PM2.5 episode, which took place from Thursday, January 11 through Sunday, January 21, 2007 inclusive. Specifically, for each of these days, sets of 24 hourly temperatures were obtained from representative monitors in each of the seventeen counties. An average temperature was obtained for each separate hour by averaging the daily temperatures for each specific hour.

The resulting daily temperature profile is a set of 24 average hourly temperatures. Each hourly temperature in the profile is the average of the eleven hourly temperatures that were recorded over the eleven episode days.

Projected vehicle miles traveled (VMT) for the seven counties that were modeled by one of the Metropolitan Planning Organizations (MPO) were obtained from their respective Travel Demand Models. VMT projections for the ten remaining, mostly rural counties were obtained as follows:

1. Utah Department of Transportation (UDOT) provided historical VMT in units of Average Annual Daily Traffic (AADT) for calendar years 1996 - 2009.

2. Utah Division of Air Quality (Planning Branch, Mobile Sources and Transportation Section) performed linear regressions on historical AADT VMT to obtain future year AADT VMT projections.

3. UDOT provided conversion factors to change AADT VMT to winter average weekday and weekend day traffic (win AWKDT and win AWKNDT). Conversion factors were provided for six major road types: urban interstate/freeway, urban arterial and local roads; rural interstate/freeway, rural arterial and local roads. In addition, conversion factors were provided for the month of January and separately for a weekday and a weekend day. The composite weekday factor was obtained from the five weekday (Monday - Friday) factors; the composite weekend day factor was obtained from the two weekend day (Saturday, Sunday) factors.

 EPA guidance requires that States create a mobile source inventory that uses the most recent available data for fleet characterization, transportation/traffic conditions, fuel parameters and meteorological data. Model development relied primarily on interagency consultation procedures to ensure the best mix of local and default MOVES2010a inputs.

Model development included discussions on the following topics: MOVES default database scale modifications, GUI selections, County Data Manager input development utilizing local and default data, and output selection for air dispersion modeling. The following agencies provided MOVES modeling development through the interagency consultation procedures.

Cache Metropolitan Planning Organization (CMPO)
EPA Office of Transportation and Air Quality: MOVES Team (OTAQ)
FHWA Resource Center: Air Quality Team (FHWA)
Utah Department of Transportation Systems Planning & Programming: Traffic Analysis
Utah Division of Air Quality (UDAQ)
Utah Division of Motor Vehicles (UDMV)
Mountainland Association of Governments (MAG)
Wasatch Front Regional Council (WFRC)

In the discussion below, each topic will be discussed along with modifications that were made to model the 2010 baseline inventory and 2015 projection year inventories.

(1) PM2.5 SIP Modeling Domain Responsibilities

As was done to create the episode day inventories, the modeling domain was divided into four groups: counties modeled by each Metropolitan Planning Organization (MPO), and counties modeled by UDAQ Planning Branch (Mobile Sources and Transportation Section):

Agency	Non-Attainment	County(-ies)	Coordinator
Cache MPO	Logan, UT	Cache	Jeff Gilbert
MAG	Provo, UT	Utah	Susan Hardy
WFRC	Salt Lake City, UT	Box Elder, Davis, Salt Lake, Tooele, Weber	Kip Billings
UDAQ	none	Carbon, Duchesne, Emery, Juab, Millard, Morgan, Rich, Sanpete, Summit, Wasatch	Rick McKeague Peter Verschoor

(2) PM10 and PM2.5 Fugitive Dust from Paved Roads

PM10 and PM2.5 fugitive dust from paved roads (re-entrained road dust) was modeled by UDAQ for each of the seventeen counties.

The latest EPA-approved version of AP-42, Chapter 13, "Miscellaneous Sources", Section 1.2.1, "Paved Roads" (January 2011), was used to compute the emission factors for PM10 and PM2.5 fugitive dust.

Key inputs to compute the emission factors are:

Average vehicle weight for each data pair (county, road type); units are tons
Silt loading factor for each road type; units are grams per square meter (gm/m2)
Particle size multiplier "k" for PM10 and PM2.5; (unitless)
Precipitation for each data pair (county, episode day); units are number of hours per episode day with precipitation greater than 0.01 inch.

Vehicle miles traveled (VMT) were identical to VMT used in the MOVES model.

(3) VOC Refueling Emissions

The baseline (2010) and projection year inventories that were initially modeled with MOVES2010a included VOC refueling emissions in all 17 counties modeled.

For purposes of SIP motor vehicle budgets and conformity demonstrations, UDAQ and the MPOs have traditionally set motor vehicle budgets which *do not* include VOC refueling emissions. Subsequent conformity determinations will also *exclude* refueling emissions.

The MPOs performed a MOVES query to isolate VOC refueling emissions. Affected counties include Box Elder, Cache, Davis, Salt Lake, Tooele, Utah and Weber. VOC refueling emissions for these counties were reported to the Area Source inventory.

viii. Procedure

The same interagency consultation process was used to develop the base year and projection year inventories that were used when the episode inventories were developed.

The discussion below identifies the procedures followed to model the baseline and projection year inventories. A detailed explanation of each procedure is found below.

(1) **MOVES2010a Procedures**

1. MOVES Default Database Scale Modifications: daily VMT and local roads.
2. MOVES2010a GUI Selections: description, scale, time span, geographic bounds, road type, pollutants and processes, alternative vehicle fuels and technologies
3. MOVES2010a County Data Manager input development

(a) MOVES Default Modifications

Before the episode inventories were created, UDAQ consulted with the EPA OTAQ MOVES Team during the development and testing of MOVES2010a.

At that time, two changes were made to the MOVES2010a database:

1) a scale modification to daily instead of annual inputs; and

2) addition of rural and urban local roads along with their unique operational characteristics and inputs, particularly the difference in truck travel fractions on these roads compared to freeways and arterials.

The modified database has been named UTAH MOD MOVESDB20100830 and has been adopted by UDAQ and the MPOs: Cache MPO, Mountainland Association of Governments and Wasatch Front Regional Council. A discussion of the steps taken to modify the core MOVES database follows.

(b) Daily VMT

The scale modification developed by UDAQ and reviewed by the EPA MOVES Team allows the MOVES model to use daily VMT as an input. The MOVES default database requires the user to convert daily VMT into an annual VMT input before it is entered into the MOVES model. The MOVES default database model operates on annual VMT; then MOVES converts the VMT internally, and the output is returned as daily VMT. The process of using MOVES to convert daily VMT to annual VMT and back to daily VMT is unlike the process used in the MOBILE model. The modifications to MOVES eliminate the process of converting daily VMT to annual and back to daily VMT.

The VMT scale modification to "daily" simplifies the use of MOVES, and allows the user to identify errors in inputs and outputs easily.

The scale modification allows the user multiple advantages: 1) Highway Performance Monitoring System (HPMS) VMT collected by UDOT for FHWA and Travel Demand Model VMT estimates are recorded in units of average daily VMT, so no annual conversion is

necessary. 2) The MOBILE model historically used daily VMT, so comparison of results is easier.

The procedures used for creating the scale modifications for the UTAH MOD MOVESDB20100830 database are the same as were discussed in the episode day section of the TSD. The discussion on the modifications to MOVES inputs are presented below for the reader's convenience, and are identical to the modifications made to process the episode days:

Daily Modifications

Table Name	Data Columns	Description of Changes
dayofanyweek	noOfRealDays	Weekday number of real days changed from 5 to 7; weekend day number of real days changed from 2 to 7.

dayID	dayName	noOfRealDays
5	Weekdays	7
2	Weekend	7

Table Name	Data Columns	Description of Changes
dayvmtfraction	dayVMTFraction	All dayVMTFractions set to 1.

sourceTypeID	monthID	roadTypeID	dayID	dayVMTFraction
11	1	1	2	1
11	2	1	2	1
11	3	1	2	1
Etc				

Table Name	Data Columns	Description of Changes
monthofanyyear	noOfDays	All noOfDays set to 1.

monthID	monthName	noOfDays	monthGroupID
1	January	1	1
2	February	1	2
3	March	1	3
4	April	1	4
5	May	1	5
6	June	1	6
Etc			

Table Name	Data Columns	Description of Changes
monthVMTfraction	monthVMTfraction	All number of days per month set to 1

sourceTypeID	isLeapYear	monthID	monthVMTFraction
11	N	1	1
11	N	2	1
11	N	3	1
11	N	4	1
11	N	5	1

(c) Local Roads

The MOVES default database requires the user to use identical vehicle type profiles for arterial and local roads, but a local road modification allows MOVES to model local road types separately. UDAQ and the MPOs believe that arterial and local roads have different traffic characteristics, such as VMT, speed distribution and VMT mix. Modeling these road types separately will create a more accurate inventory than combining arterial and local roads into one road type.

Local Road Modifications

Table Name	Data Columns	Description of Changes
avgspeeddistribution	roadTypeID avgSpeedBinID	Road types rural local(32)and urban local(52)added. Local average speeds were set to a constant speed of 12.9 mph.

sourceTypeID	roadTypeID	hourDayID	avgSpeedBinID	avgSpeedFraction
21	32	135	3	0.42
21	32	135	4	0.58
21	52	135	3	0.42
21	52	135	4	0.58
Etc				

Table Name	Data Columns	Description of Changes
drivescheduleassoc	roadTypeID driveScheduleID	Road types rural local(32)and urban local(52) added. Road types 3 and 5 drive schedules copied to road types rural local(32)and urban local(52).

sourceTypeID	roadTypeID	isRamp	driveScheduleID
21	52	N	101
21	52	N	158
21	52	N	1009
21	52	N	1024
21	52	N	1025
21	52	N	1026
21	52	N	1029
21	52	N	1030
21	52	N	1041
21	52	Y	199

Table Name	Data Columns	Description of Changes
hourvmtfraction	roadtypeid hourVMTFraction	Road types rural local(32) and urban local(52) added. Road types 3 and 5 hourvmtfraction copied to road types rural local(32)and urban local(52).

sourceTypeID	roadTypeID	dayID	hourID	hourVMTFraction
21	52	2	1	0.0214739
21	52	2	2	0.0144428
21	52	2	3	0.0109684
21	52	2	4	0.00749451
21	52	2	5	0.00683855
21	52	2	6	0.0103588
etc.				

Table Name	Data Columns	Description of Changes
roadtype	roadTypeID roadDesc	Road types rural local(32) and urban local(52) added.

roadTypeID	roadDesc	rampFraction
1	Off-Network	0
2	Rural Freeway	0
3	Rural Arterial	0
4	Urban Freeway	0
5	Urban Arterial	0
32	Rural Local	0
52	Urban Local	0

Table Name	Data Columns	Description of Changes
roadtypedist	roadtypeID, roadTypeVMTFraction	Road types rural local(32) and urban local(52) added. RoadtypeVMTfractions for six road types normalized back to 1.000.

sourceTypeID	roadTypeID	roadTypeVMTFraction
21	1	0
21	2	0.352377
21	3	0.28582
21	4	0.105003
21	5	0.176076
21	32	0.0396498
21	52	0.0410736
Etc		

Table Name	Data Columns	Description of Changes
zoneroadtype	roadTypeID SHOAllocFactor	Road types rural local(32) and urban local(52) added. SHOAllocFactors for road types 3 and 5 copied to road types 32 and 52.

zoneID	roadTypeID	SHOAllocFactor
490030	2	0.00207141
490030	3	0.000346871
490030	4	0
490030	5	0.0000792
490030	32	0.000346871
490030	52	0.0000792

(d) Source Classification Codes (SCC's) for Local Roads

To allow local roads to be modeled separately and to use the correct SCC road type fractions, the SCC road type codes and fractions were modified. This modification allowed the modelers to quickly identify if the MOVES model was performing calculations on inputs used for urban and rural freeways, arterials, and local roads.

MOVES SCC Road Types

SCCRoadTypeID	SCCRoadTypeDesc
1	Off-Network
11	Rural Interstate
13	Rural Principal Arterial
15	Rural Minor Arterial
17	Rural Major Collector
19	Rural Minor Collector
21	Rural Local
23	Urban Interstate
25	Urban Freeway/Expressway
27	Urban Principal Arterial
29	Urban Minor Arterial
31	Urban Collector
33	Urban Local

```
Table Name                    Data Columns            Description of Changes
sccroadtypedistribution       roadtypeid              Road types rural local (32)and
                              sccroadtypeid           urban local (52)added.
                              sccroadtypefraction     SCCroadtype ID consolidated to
                                                      1, 11, 13, 23, 27, 21, and 33.
                                                      SCCroadtypefractions set to 1.


roadTypeID   zoneID   SCCRoadTypeID   SCCRoadTypeFraction
    1        490310         1                  1
    2        490310         11                 1
    3        490310         13                 1
    4        490310         23                 1
    5        490310         27                 1
   32        490310         21                 1
   52        490310         33                 1
```

(2) **MOVES2010a Graphical User Interface (GUI) Selections**

The following MOVES2010a GUI selection inputs were entered for each of seventeen counties and projection year winter weekdays and weekend days:

Description: Contains the name of the county being modeled, season and
                                type of day and year.

Scale: Domain/Scale: County
                                Calculation Type: Inventory

Time Span: Years Season Days
Geographic Bounds: States: Utah

Counties: 17 counties in Utah

Vehicles/Equipment: On-road Vehicle Equipment
Fuels: Gasoline and Diesel (all vehicle gasoline and diesel fuel combinations allowed)

Road Type: Off-Network (exhaust and evaporative emissions emitted in areas other than
                roads, e.g., in parking lots, residential driveways and garages.
                Rural Arterial
                Rural Freeway
                Rural Local
                Urban Arterial
                Urban Freeway
                Urban Local

Not all counties include all of the above road types. For example, there are no freeways or interstates in Cache County.

Pollutants and Processes:

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Pollutants                              Processes

Ammonia (NH3)                           Running Exhaust, Start Exhaust,
Carbon Monoxide (CO)                    Crankcase, Idle
Nitrogen Oxide (NO)
Oxides of Nitrogen (NOx)
Primary Exhaust PM10 & 2.5
Primary PM10 & 2.5 Elemental Carbon
Primary PM10 & 2.5 Organic Carbon
Primary PM10 & 2.5 Sulfate Particulate
Primary PM10 & 2.5 Sulfate Particulate
Sulfur Dioxide (SO2)

Primary PM10 & 2.5                      Brake wear, Tire wear
Non-methane Hydrocarbons                Crankcase, Refueling, Idle

Total Energy                            Running Exhaust, Start Exhaust, Idle
Total Gaseous Hydrocarbons              Running Exhaust, Start Exhaust,
Volatile Organic Compounds              Evaporative, Crankcase, Refueling,
                                        Idle
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(a) <u>VOC Refueling Emissions</u>

VOC refueling emissions are emitted when individual vehicles refuel at gasoline stations. In MOVES2010a, refueling emissions consist of two components:

1) refueling displacement vapor loss; and
2) refueling spillage loss.

When the baseline (2010) and projection year inventories were initially run using MOVES2010a, VOCs included refueling emissions.

For purposes of SIP motor vehicle budgets and conformity demonstrations, UDAQ and the MPOs have traditionally set motor vehicle budgets which *do not* include VOC refueling emissions. Subsequent conformity determinations will also *exclude* refueling emissions.

VOC refueling emissions were reported to the Area Source inventory.

(b) <u>Strategies: Alternative Vehicle Fuels & Technologies</u> (AVFT)

MOVES2010a includes a national default AVFT file that contains default fuel engine fractions for gasoline, diesel, and CNG vehicles by model year.

AVFT file fractions for diesel and gasoline were changed from default to local values in all 17 counties. The source of this data was Utah Tax Commission, Division of Motor Vehicles (DMV), who provided gasoline and diesel passenger and light truck counts for the five largest counties: Davis, Salt Lake, Utah, Weber and Cache. Data was current to March 2011. Only source types 21, 31 and 32 were changed, beginning with 1999.

The default AVFT file contains CNG fractions for transit buses at 6%, but the Utah Transit Authority is currently only operates five CNG buses out of 501 buses as of 2009.[1] The AVFT file was modified by setting all CNG fractions for transit buses (42) to zero, and re-normalizing the sum of fractions for diesel and gasoline transit buses to exactly 1.0000.

AVFT for CNG Transit Buses

sourceTypeID	modelYearID	fuelTypeID	engTechID	fuelEngFraction
42	2007	3	1	0.06
42	2008	3	1	0.06
42	2009	3	1	0.06
42	2010	3	1	0.06

Output/General Output: Units: Grams, Million BTU, Miles

   Activity: Distance Traveled
   Source Hours
   Source Hours Idling
   Source Hours Operating
   Source Hours Parked

Population
   Starts

Output/Output Emissions Detail: Always: 24-hr and County
   For All Vehicles: Emissions Process
   On-road: SCC
   Population
   Starts
   Detail: Always: 24-hr and County
   For All Vehicles: Emissions Process
   On-road: SCC

The MOVES input files are text files with a file name extension of ".mrs". All input files are found in Appendix.

MOVES Files SL P\UDAQ\MRS
MOVES Files SL P\CMPO\I/M\MRS
MOVES Files SL P\CMPO\No I/M\MRS
MOVES Files SL P\MAG\MRS\
MOVES Files SL P\WFRC\MRS\

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[1]See UTA website, http://www.rideuta.com/. On the dark blue menu at the top of the page, choose "Media Room". Then choose the underscored wording "UTA Publications".   Then choose the underscored wording "Annual Reports". Click on "2009 Comprehensive Annual Financial Report". Statistical data begins on p. 63 of 85. Go to page 78 to find the number of buses in operation each calendar year.

(3) **MOVES2010a County Data Manager Input Development**

The following inputs were developed for the MOVES County Data Manager:

(a) County Data Manager Excel Development Workbooks

MOVES organizes data inputs into tables called County Data Manager (CDM) tables.

CDMs were developed for each of the seventeen counties in the domain for each modeled calendar year (2010, 2015).

The table below shows the names of the CDM tables, the agency who developed the data, and the agencies who used the data.

Name of CDM	Cache MPO (CMPO)	Mountainlands Association of Governments (MAG)	Wasatch Front Regional Council (WFRC)	UT Division of Air Quality (UDAQ)
Met Data	UDAQ	UDAQ	UDAQ	UDAQ
Source Type Age Distribution	UDAQ	UDAQ	WFRC	UDAQ
Vehicle Miles of Travel	CMPO	MAG	WFRC	UDAQ
Vehicle Type VMT Mix	UDAQ	UDAQ	UDAQ	UDAQ
Road Type Distribution	UDAQ	MAG	WFRC	UDAQ
Average Speed Distribution	CMPO	MAG	WFRC	UDAQ
Ramp Fractions	CMPO	MAG	WFRC	UDAQ
Day VMT Fractions	UDAQ	UDAQ	UDAQ	UDAQ
Fuel Type ID	Utah Petroleum Association	→	→	→

Name of CDM	Cache MPO (CMPO)	Mountainlands Association of Governments (MAG)	Wasatch Front Regional Council (WFRC)	UT Division of Air Quality (UDAQ)
Hour VMT Fraction	MOVES Default	→	→	→
I/M Coverage	CMPO and UDAQ	MAG and UDAQ	WFRC and UDAQ	n/a (no IM programs in rural counties)
Month VMT Fraction	MOVES Default	→	→	→

CDMs

The CDMS are found in Appendix.

PM 2.5 MOVES Files SL P\UDAQ\CDM\
PM 2.5 MOVES Files SL P\CMPO\IM\CDM\
PM 2.5 MOVES Files SL P\CMPO\No IM\CDM\
PM 2.5 MOVES Files SL P\MAG\CDM\
PM 2.5 MOVES Files SL P\WFRC\CDM\

County Data Manager Input   Data Sets

Meteorology Data
PM 2.5 MOVES Files SL P\File Development\July 20, 2011 Temperature Study\
PM 2.5 MOVES Files SL P\File Development\Met data\Zonemonthhour\Met Data\
Note: See CDMs above.

Source Type Population
PM 2.5 MOVES Files SL P\UDAQ\File Development\Sourcetypeyear\
PM 2.5 MOVES Files SL P\CMPO\File Development\Sourcetypeyear\
PM 2.5 MOVES Files SL P\MAG\File Development\Sourcetypeyear\
PM 2.5 MOVES Files SL P\WFRC\File Development\Vehicle Population\
Note: See CDMs above.

Age Distribution
PM 2.5 MOVES Files SL P\Projections\UDAQ\FileDevelopment\Soucetypeagedistribution\
PM 2.5 MOVES Files SL P\CMPO\File Development\Soucetypeagedistribution\
PM 2.5 MOVES Files SL P\MAG\File Development\Soucetypeagedistribution\
PM 2.5 MOVES Files SL P\WFRC\File Development\Vehicle Age\
Note: See CDMs above.

Vehicle Miles Traveled and Vehicle Type Mix
PM 2.5 MOVES Files SL P\UDAQ\File Development\Hpmsvtypeyear\
PM 2.5 MOVES Files SL P\CMPO\\File Development\Hpmsvtypeyear\
PM 2.5 MOVES Files SL P\MAG\File Development\Hpmsvtypeyear\
PM 2.5 MOVES Files SL P\WFRC\File Development\VMT Mix\

Average Speed Distribution
PM 2.5 MOVES Files SL \UDAQ\File Development\Avgspeeddistribution\EMIT & Rural Speeds\
Note: See CDMs above.

Fuel
PM 2.5 MOVES Files SL P\Fuelsupply\
Note: See CDMs above.

I/M Programs
Note: See CDMs above.

Data for the CDMs discussed below were developed by UDAQ. However, for many of the CDM tables, the MPOs opted to develop their own inputs. The agency who developed each CDM is noted in the discussion of CDMs by topic below.

(1) <u>Meteorological Data</u> (Zone Month Hour)

UDAQ developed all meteorological data. All MPOs and UDAQ used these data, which was specific to each county in the domain.

Meteorological data is identified in the database as Zone Month Hour data. This data consists of hourly temperature (°F) and relative humidity values (%) for each separate county and episode day. Data were collected by the UDAQ Planning Branch, Technical Analysis Section.[2]

See Appendix:
PM 2.5 MOVES Files SL P\File Development\July 20, 2011 Temperature Study\

The EPA document "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze", (Final-03-pm-rh-guidance.pdf) explains the difference between the base case and baseline inventories and the meteorological data to be used for each. Air quality episode dates must fall within the five-year air quality design value window discussed in that document.

Base case episode inventories are used for air dispersion model performance evaluation. Baseline (2010) inventories used by air dispersion model to determine the "Relative Reduction Factor" (RRF), which establishes the increment between the modeled and attainment concentration.

Four PM2.5 episodes were identified by UDAQ Air Modelers. Dates of these episodes were from 2007 to 2010.

Averages of 24-hour temperature data during each episode showed that January 2007 episode temperatures were considerably colder than the averages during the other three episodes (February 2008, January 2009 and December 2009 - January 2010). The MOVES model showed that, when all other inputs were held constant, emissions were highest when the coldest temperatures were modeled--those recorded during the January 2007 episode.

EPA Region 8, EPA OTAQ, the Metropolitan Planning Organizations and UDAQ concurred that, for the baseline (2010) and projection year inventories, the January 2007 average hourly temperatures should be modeled, as use of these constitute the most conservative modeling approach, i.e., which models "worst-case" conditions.

Meteorology data for the baseline and projection year inventories includes a data set for each of the seventeen counties in the domain.

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[2]From the home page at, http://mesowest.utah.edu/index.html . On the map, click on the outline of Utah. On the upper menu (red bar), under "Product", choose "Current Weather Summary (instead of "Surface Weather Maps") and click on "GO". Then choose a station name, e.g., "Salt Lake City I" (Salt Lake City International Airport).
   To find a different station, go to the menu on the left-hand side of the page. Under "MORE INFO", choose "Nearby Stations" and select a different city or station.

Temperature and relative humidity (RH) input data represent the average values recorded on episode days Thursday, January 11 through Sunday, January 21, 2007 inclusive (eleven days).

For each episode day, there are 24 hourly values of temperature (F) and RH (%).

Computation of average values can best be explained by example:

Consider Salt Lake County. Beginning with January 11 and ending with January 21, 2007 for the first hour (1:00), temperature and RH values were recorded as follows:

County	FIPs	Episode Day of Week	Date	Hour	T(F)	RH (%)
Salt Lake	49035	Thu	01-11-07	1:00	17.9	75
Salt Lake	49035	Fri	01-12-07	1:00	20.5	83
" "	49035	Sat	01-13-07	1:00	11.5	47
"	49035	Sun	01-14-07	1:00	8.2	66
"	"	Mon	01-15-07	1:00	7.5	76
"	"	Tue	01-16-07	1:00	9.9	77
"	"	Wed	01-17-07	1:00	11.1	80
"	"	Thu	01-18-07	1:00	13.3	85
"	"	Fri	01-19-07	1:00	15.6	84
"	"	Sat	01-20-07	1:00	16.7	91
"	"	Sun	01-21-07	1:00	25.0	76
"	"	AVERAGE	11 Days	1:00	17.9	75

Average values for the first hour (1:00), which are 17.9 F and 75% as seen above, are entered into the data set for the final episode average T and RH for the first hour.

For the *second* hour (2:00), data was collected the same way--the eleven daily values for the 2:00 hour were gathered and averaged. The process was repeated to calculate subsequent hourly averages for hours 3:00 through 24:00. The result consists of 48 average hourly values: 24 average hourly temperature values and 24 average hourly RH values.

Thus, from the above example, the episode average T and RH for the *first hour only* (1:00) are 17.9 F and 76% respectively.

The final data set contains 24 *hourly average temperatures* and 24 *hourly average RH* values.

(2) <u>Source Type Population</u>

Source type population (vehicle population) is a new input for the MOVES model. MOVES2010a uses entirely different source (vehicle) types compared to MOBILE6.

The MOBILE6 input file required users to enter data for sixteen vehicles types. The MOBILE6 short output file defined eight vehicle types. Users could select the long output format, which defined 28 vehicle types.

MOVES2010a requires input for thirteen vehicle types. Output choices are thirteen vehicle types or twelve-vehicles. The 12-vehicle output is similar to the eight-vehicle output from MOBILE6 but expands heavy-duty diesel vehicles into five classes by Gross Vehicle Weight Rating (GVWR).

These twelve vehicle types are the following:

```
SCC       Vehicle Type and                 GVWR              Loaded Vehicle
          Description                      (lb)               Weight, LVW (lb)

2201001   Light-duty passenger car         0 < G <      3750
2201020   Light-duty gasoline truck 1,2    0 < G <      6000     0 < L < 3750
2201040   Light-duty gasoline truck 3,4    0 < G <      6000  3750 < L < 6000
2201070   Heavy-duty gasoline vehicle      0 < G <     33000
2201080   Motorcycle
2230001   Light-duty diesel vehicle        0 < G <      3750
2230060   Light-duty diesel truck          0 < G <      8500
2230071   Heavy-duty diesel vehicle 2b      8500 < G < 10000
2230072   Heavy-duty diesel vehicle 3,4,5  10000 < G < 19500
2230073   Heavy-duty diesel vehicle 6, 7   19500 < G < 33000
2230074   Heavy-duty diesel vehicle 8a, 8b       G > 33000
2230075   Buses (intercity, sch & transit) 19500 < G < 33000
```

The "crosswalk" between MOBILE6 and the thirteen MOVES source types is found in the EPA Age Distribution Importers, "Vehicle Type Mapping" tab:

		Composite Vehicle Classes for Vehicle Registration Data from MOBILE6		
M6Vtype16ID	**Abbreviation**	**Description**	**HPMSVtypeID**
	LDV	Light-Duty Vehicles (Passenger Cars)	20
2	LDT1	Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)	30
3	LDT2	Light-Duty Trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)	30
4	LDT3	Light-Duty Trucks 3 (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW)	30
5	LDT4	Light-Duty Trucks 4 (6,001-8,500 lbs. GVWR, 5,751 lbs. and greater ALVW)	30
6	HDV2B	Class 2b Heavy-Duty Vehicles (8,501-10,000 lbs. GVWR)	30
7	HDV3	Class 3 Heavy-Duty Vehicles (10,001-14,000 lbs. GVWR)	50
8	HDV4	Class 4 Heavy-Duty Vehicles (14,001-16,000 lbs. GVWR)	50
9	HDV5	Class 5 Heavy-Duty Vehicles (16,001-19,500 lbs. GVWR)	50
10	HDV6	Class 6 Heavy-Duty Vehicles (19,501-26,000 lbs. GVWR)	50
11	HDV7	Class 7 Heavy-Duty Vehicles (26,001-33,000 lbs. GVWR)	50
12	HDV8A	Class 8a Heavy-Duty Vehicles (33,001-60,000 lbs. GVWR)	60
13	HDV8B	Class 8b Heavy-Duty Vehicles (>60,000 lbs. GVWR)	60
14	HDBS	School Buses	40
15	HDBT	Transit and Urban Buses	40
16	MC	Motorcycles (All)	10

	MOVES SourceUseType Vehicle Categories	
SourceTypeID	**SourceTypeName**	**HMPSVtypeID**
11	Motorcycle	10
21	Passenger Car	20
31	Passenger Truck	30
32	Light Commercial Truck	30
41	Intercity Bus	40
42	Transit Bus	40
43	School Bus	40
51	Refuse Truck	50
52	Single Unit Short-Haul Truck	50
53	Single Unit Long-Haul Truck	50
54	Motor home	50
61	Combination Short-Haul Truck	60
62	Combination Long-Haul Truck	60

Development of Source (Vehicle) Type Population

UDAQ developed data for Source Type Population. CMPO and MAG used this data. WFRC developed its own data.

UDAQ Method

Ideally, states have sources that provide a statewide vehicle population.

In Utah, the Division of Motor Vehicles maintains a database of registered on-road vehicles. However, discussions with DMV found that the database does not include heavy-duty vehicles that travel interstate (into Utah and merely passing through to adjoining states).

In addition, the vehicle type classifications in the DMV db are very simple, and only include motorcycles, passenger car/light trucks as a second single group, and heavy-duty trucks.

Utah proposed to use DMV data to develop the population for light-duty passenger cars and light-duty trucks only. The heavy-duty truck count from DMV is incomplete.

To obtain an estimate of the heavy-duty truck population by MOVES types, EPA OTAQ assisted staff in performing a source type population run. The run specifications are described below.

In summary, source populations by type were obtained as follows:

1. Light-duty passenger cars and light-duty trucks: UT Division of Motor Vehicles (DMV)
2. Heavy-duty trucks: MOVES defaults

As shown in the diagram below, the UDMV class "light-duty vehicles" includes those with GVWR up to 12,000 lb. UDAQ assigned these to MOVES classes 11, 21, 21 and 32.

This assignment is only an approximation based on the following assumptions: Some vehicles in the light-duty group have GVWRs from 10,000 to 12,000 lbs. These vehicles belong in MOVES vehicle type decile 50 (see "crosswalk" above).

The more accurate way to assign light-duty vehicles with GVWR from 10,000 to 14,000 lbs is to distribute them among MOVES vehicle types 30 and 50. However, there is no way to determine the exact fractions of vehicles that belong in each class. For this reason, UDAQ believes the assignment of LDV's to MOVES classes 11, 21, 31 and 32 is sufficiently accurate. The UDMV class of heavy-duty vehicles is defined by a GVWR greater than 12,000 lbs. UDAQ assigned these to MOVES classes 41 through 62.

The diagram below illustrates how DMV and UDAQ grouped the vehicles:

UTAH DMV DATABASE OF VEHICLES
Current to Jan 1, 2010

Light-duty Vehicles	Heavy-duty Vehicles
MC, LDV & LDT 1-4, HDV2b	HDV 3 – 8b, Buses
GVWR ≤ 12,000 lb	GVWR > 12,000 lb

UT DOT Vehicle Apportionment by GVWR

LDV	LDV	HDV	HDV	HDV	HDV	HDV	HDV	HDV	HDV
≤ 6,000	6,000 > GVWR ≤ 8,500	8,500 > GVWR ≤ 10,000	10,000 > GVWR ≤ 14,000	14,000 > GVWR ≤ 16,000	16,000 > GVWR ≤ 19,500	19,500 > GVWR ≤ 26,000	26,000 > GVWR ≤ 33,000	33,000 > GVWR ≤ 60,000	> 60,000

M6 Types	MOVES Types	GVWR (lb)
MC	MC (11)	n/a
LDV	passenger car (21)	≤ 3,750
LDT 1-4	passenger truck (31)	≤ 8,500
HDV2b	light commercial truck (32)	8,500 < G ≤ 10,000

M6 Types	MOVES Types	GVWR (lb)
HDV 3-7	refuse truck, single-unit short- and long-haul truck (51 – 54)	10,000 < GVWR ≤ 33,000
HDBS, HDBT	buses (41 - 43)	n/a
HDV 8a, 8b	combination short- and long-haul truck (61, 62)	> 33,000

The table below contains vehicle counts from UDMV current to January 1, 2009:

	HEAVY TRUCK	MC	PASS VEH	LT TRUCK	SUM
Box Elder	1983	1605	27437	15922	44964
Cache	2809	3641	50987	24782	79410
Carbon	938	760	11252	8932	20944
Davis	3600	8891	151,157	55979	216,027
Duchesne	1873	549	8180	9803	18532
Emery	409	265	5451	4869	10585
Juab	505	253	5306	3905	9464
Millard	649	288	6676	5093	12057
Morgan	297	292	5394	3425	9111
Rich	117	46	1304	1119	2469
Salt Lake	22753	26897	524,480	191,640	743,017
Sanpete	977	463	12426	9301	22190
Summit	991	1583	25508	12480	39571
Tooele	972	1805	29601	15326	46732
Utah	7055	12827	210456	81570	304,853
Wasatch	635	828	12205	7417	20450
Weber	5436	6920	109608	51289	167,817
SUM	53348	67913	1197428	502852	1,768,193

Data current to January 1, 2011 are shown below:

	HEAVY TRUCK	MC	PASS VEH	LT TRUCK	SUM
Box Elder	1903	1472	27151	15733	44356
Cache	2940	3182	51831	24979	79992
Carbon	984	690	10996	8702	20388
Davis	3478	8120	151,957	54642	214,719
Duchesne	1994	519	8059	9735	18313
Emery	479	245	5399	4836	10480
Juab	540	187	5302	3951	9440
Millard	583	285	6610	5066	11961
Morgan	309	293	5585	3354	9232
Rich	92	41	1236	1095	2372
Salt Lake	21761	24468	521088	181764	727,320
Sanpete	989	462	12618	9482	22562
Summit	929	1500	26073	12187	39760
Tooele	1146	1734	30334	15509	47577
Utah	6853	11089	213850	80186	305,125
Wasatch	588	775	12530	7330	20635
Weber	4963	6420	108516	50490	165,426

```
              SUM    50531  61482  1199135   489041  1,749,658
```
As discussed above, the UT DMV classifies registered vehicles as follows:

Vehicle Type   GVWR (lb)

Passenger Vehicle/Light Truck $\leq$ 12,000
Heavy Truck   > 12,000

The DMV heavy truck count does not include vehicles merely passing through the state, such as heavy-duty long-haul trucks.

Therefore, MOVES defaults were used to estimate the populations of heavy-duty trucks.

MOVES Default Source Type Population Run

The starting point to develop heavy-duty (vehicle) type populations from MOVES is to set up a "national scale" run.

To perform the MOVES Population Run the following GUI selection inputs were used:

Settings: Configure MOVES Default Database: movesdb20100830
Description: Contains the name of all the counties modeled.

Scale: Domain/Scale: National, Calculation Type: Inventory

Time Span: Time Aggregation Level: Month, Years: 1990, 1999-2050
                Months: January, Days: Weekend & Weekday, Hours: 24

Geographic Bounds: States: Utah
                Counties: All 17 counties in the Utah PM 2.5 SIP modeling domain

Vehicles/Equipment: On-road Vehicle Equipment
                Fuels: Gasoline and Diesel, all allowed vehicle gasoline and diesel fuel combinations

Road Type: Off-Network
                Rural Restricted Access
                Rural Unrestricted Access
                Urban Restricted Access
                Urban Unrestricted Access

Pollutants: At least one pollutant needs to be selected, e.g.,
                Carbon Monoxide: running, start, crankcase, idle

Output/General Output: Units: Grams, Joules, Miles
                Activity: Distance Traveled
                Output/Output Emissions Detail: Always: Month and County
                For All Vehicles: Fuel Type & Emissions Process
                On-road: Road Type & Source Use Type

Advanced Performance Features: Save Data for the following Masterloop Components
       Total Activity Generator (TAG)
       Operating Mode Distribution Generation (running OMDG)
       Start Operating Mode Distribution Generator
       Tirewear Operating Mode Distribution Generator

       Copy Saved Generator Data
       Database: populationrunTAG

Upon completing the national scale run, MOVES outputs a directory called "populationruntag". The output tables "starts" and "starts per vehicle" contain the data required to compute the source populations. Source population is computed by the following equation:

$$\text{Source Population} = \text{Vehicle Starts/Starts per Vehicle}$$

The source type populations for heavy-duty vehicles (types 41-62) were extracted from the MOVES2010a default database.

UDAQ believes an adjustment should be made on the default heavy-duty vehicle counts to better reflect local data.   As already stated, DMV does not have an accurate count of heavy-duty vehicles traveling in Utah because interstate trucks (mostly types 61 and 62) driving through the state are not tracked.

Therefore, UDAQ proposed to adjust the MOVES default population for heavy-duty trucks by some metric that would better reflect the true local heavy-duty vehicle population.

An adjustment was made to the heavy-duty vehicle population as follows:

1. Default MOVES populations for the sum of *light-duty vehicles* (passenger cars and trucks and light commercial trucks) in each separate county were compared to UT DMV LDV counts by county to see how well the counts agreed.
2. A ratio of (DMV/MOVES) counts was computed separately for each group of LDV populations by county.

3. The heavy-duty vehicle counts were adjusted separately in each county by multiplying the MOVES default counts for heavy-duty vehicles by the ratio in step 2 above, i.e:

Adjusted HD Count = MOVES Default Population x (LDV DMV Count/LDV MOVES Count)

Thus if the ratio (LDV DMV/LDV MOVES) was < 1, then the HD default counts from MOVES would decrease, and if the ratio was > 1, the HD default counts would increase.

Conversion of Source Type Populations by Local UDMV data and MOVES Defaults

Passenger Cars/Light Trucks & Motorcycles	Heavy Trucks and Buses
Counts from UDMV	Counts from MOVES

```
11 motorcycle                    41  intercity bus
21 passenger car                 42  transit bus
31 passenger truck               43  school bus
32 light commercial truck        51  refuse truck
                                 52  single-unit short-
                                     haul truck
                                 53  single-unit long-
                                     haul truck
                                 54  motor home
                                 61  combination long-
                                     haul truck
                                 62  combination long-
                                     haul truck
```

Note that only CMPO and MAG used this data in modeling. WFRC developed its own source type populations.

WFRC Method

The WFRC process for determining vehicle population, like the DAQ process, also relies on Utah DMV data for light duty vehicles (MOVES vehicle types 11, 21, 31, and 32 or motor cycles, passenger cars, and light duty trucks). For heavy duty and commercial vehicles, the WFRC process again parallels the DAQ process by relying on MOVES vehicle population defaults since the local DMV data is not representative of the heavy duty and commercial vehicles operating in the Salt Lake PM2.5 non-attainment area.

Where the WFRC process differs with the DAQ process described above is in the forecasting method for estimating future year vehicle populations. This is a critical data input for SIP development as well as conformity determinations that will be required once the SIP is approved.

The WFRC desired to use human population projections as a surrogate for vehicle population. WFRC invests considerable effort in maintaining the latest human population projections for the region in order to keep travel demand model estimates grounded in the most up-to-date socio-economic data. It seems logical to base vehicle population forecasts on these human population forecasts so that vehicle population estimates are likewise base on the latest socio-economic forecasts.

WFRC compared vehicle population data from Utah DMV and human population data for the years 2002-2008 to establish the vehicle per capita relationship. Then, using the human population forecast by county as the independent variable, WFRC extrapolated the vehicle population for the years 2009-2040. Again, this approach was used for MOVES vehicle types 11, 21, 31, and 32 included in the Utah DMV data.

For heavy duty and commercial vehicle types (MOVES types 41-62), the 2008 MOVES default population for each of the Salt Lake PM2.5 non-attainment counties was identified. The default vehicle population was then extrapolated for years 2009-2040 as before using the population forecast as the independent variable.

(3) Source Type Age Distribution

UDAQ developed source type age distribution data for all counties. CMPO and MAG used this data. WFRC developed its own source type age distributions.

UDAQ Method

UDMV age distribution data current to January 1, 2010 was used to calculate the vehicle populations for motorcycle (type 11), passenger cars (type 21), and light trucks (types 31 and 32) with a gross vehicle weight rating up to 12,000 lbs with the assumption that these vehicles comprise a majority of travel within the PM2.5 SIP modeling domain.

UDMV data for heavy-duty vehicles is limited to vehicles registered in the state. The EPA MOBILE6 registration distribution converter (http://www.epa.gov/otaq/models/moves/tools.htm) was used to create age distribution files by county. UDMV data for passenger cars (type 21) and light trucks (types 31 and 32) were placed within the converter and MOVES defaults were used from the convertor for vehicle types 41 - 62.

Multiple phone conversations took place between UDAQ, the EPA MOVES Team and the FHWA Air Quality Team during the development of these files. All agencies involved found that the default MOVES data for heavy-duty vehicles for source type population and age distribution are probably more suitable than the limited local UDMV data.

WFRC Method

WFRC used a procedure very similar to that described above by DAQ for determining the age distribution of vehicles registered in Box Elder, Weber, Davis, Salt Lake, and Tooele Counties. Utah DMV data was used to determine the age profile of motorcycles, passenger cars, and light duty trucks, all of which are registered in the State. These vehicles correspond to the MOVES vehicle types 11, 21, 31, and 32. Heavy duty and commercial vehicles (MOVES types 41-62) are not well represented in the Utah DMV data because these vehicles if registered in the State may accumulate much of their activity outside the State, or these types of vehicles active in the State may actually be registered in other States and thus not represented in the Utah DMV data. Thus, for MOVES vehicle types 41-62, the default MOVES age distribution was used.

(4) Vehicle Miles of Travel (VMT)

UDAQ developed VMT data for the ten rural counties it modeled. CMPO, MAG and WFRC developed their own data for vehicle miles of travel.

UDAQ Method

The starting point for development of VMT is historical FHWA or UDOT HPMS AADT VMT
for calendar years 1996 - 2009. (At the time of inventory development, UDOT Division of
Systems Planning and Programming had not yet posted 2010 AADT VMT on its website,
http://www.udot.utah.gov/main/f?p=100:pg:0::::V,T:,530.)

HPMS reports AADT VMT for twelve "functional classes", or road types. UDAQ combined
these road types to form the six major road types below:

The "Utah modified MOVES database" includes the following road types. A single county may
have up to six different road types, as follows:

Road Type Code	Road Type
11	Rural Interstate
13	Rural Arterial
21	Rural Local
23	Urban Interstate
27	Urban Arterial
33	Urban Local

For the non-MPO counties, winter average weekday traffic (Win AWKDT) and winter average
weekend day traffic (Win AWKNDT) is found in the MOVES output files for each respective
calendar year.

To obtain AADT VMT for projection years, UDAQ used historical HPMS AADT VMT for
calendar years 1996 - 2009 supplied by UDOT. Next, linear regressions of historical VMT
versus calendar year were performed to obtain VMT projections for calendar years 2010 through
2050. The EXCEL workbook "10-04-11 AADT VMT Projections 2010 - 2050 All 17
Counties.xls" contains historical HPMS AADT, details of linear regressions and AADT VMT
projections for years 2010 - 2050.

Note that AADT VMT in the above workbook is not correct for the counties modeled by MAG
(Utah County) or WFRC (Box Elder, Davis, Salt Lake, Tooele and Weber Counties). These
MPOs adjusted their AADT VMT using their respective Travel Demand Models.

UDAQ developed a method to convert AADT VMT into winter weekday and winter weekend
day VMT. Conversion factors were obtained as follows:

For each road type, there are weekday and weekend day conversion factors for VMT. These
conversion factors were obtained from UDOT.

UDOT also supplied winter (January) VMT conversion factors for each road type.

Using Carbon County as an example, the VMT reported in the HPMS data system is converted from average annual daily traffic (AADT) to winter weekday and winter weekend day VMT as shown below:

Many counties have zero VMT for one or more of the major road types.

Example: Converting Carbon County AADT VMT to a Winter Weekday in January 2014

Year	Month	Weekday or Week-end Day Factor	Road Type	Monthly Conver-sion Factor	Weekday Conver-sion Factor	HPMS AADT	win AWKDT or win AWKNDT
2014	Jan	Weekday	Rural Freeway	0.8511	0.9991	995,936	846,842
2007	"	Weekday	Rural Arterial	0.8097	1.0186	225,805	186,235
2007	"	Weekday	Rural Local	0.8711	1.0792	40,691	38,253
2007	"	Weekday	SUM			1,262,432	1,071,330

VMT Conversion Factors

For the PM2.5 SIP inventories, AADT VMT must be converted to winter average weekday traffic (Win AWKDT) and winter average weekend day traffic (Win AWKNDT).

MAG and WFRC Methods

MAG and WFRC condensed the above six road types to include, for the MPO counties (Box Elder, Davis, Salt Lake, Tooele, and Weber for WFRC, and Utah County for MAG), only three road types:

1. Urban Interstate/Freeway
2. Urban Arterials
3. Urban Local Roads
MPO Counties used their respective Travel Demand Models (TDM) to obtain modeled HPMS VMT for the base year (2010) and projection years (2015).

Next, HPMS VMT was adjusted to match traffic conditions dictated by the TDMs. The result is Adjusted HPMS VMT.

AADT VMT was converted to Average Weekday Traffic (AWKDT) and Average Weekend Day Traffic (AWKNDT) using conversion factors obtained by the respective TDMs operated by the MPOs.

Lastly, winter (January) VMT conversion factors were supplied by UDOT or obtained from the TDMs.

Winter average weekday traffic (Win AWKDT) and winter average weekend day traffic (Win AWKNDT) is found in the MOVES output files for each respective calendar year in the same way as for the base year VMT described above.

NOTE that, for the MPO counties, the above EXCEL workbooks do not show the actual projection year VMT used in modeling. Instead, VMT used is found in the MOVES output files.

CMPO Method

CMPO developed VMT for rural arterials, rural local roads, urban arterials and urban local roads. There are no interstates/freeways in Cache County.

1. UDOT HPMS AADT VMT was obtained for calendar years 2002 - 2009.
2. For calendar year 2010, UDOT VMT was not yet available at the time MOVES modeling was performed. CMPO performed a straight-line interpolation to obtain 2010 AADT VMT.
3. Using the Cache Travel Demand Model (TDM), UDOT HPMS AADT VMT for calendar years 2005 - 2010 was adjusted to account for traffic parameters such as average speed distribution, VMT by Hour and Vehicle Hours Traveled (VHT). In short, the result was that local road urban AADT VMT decreased slightly, while VMT on the remaining road types remained unchanged.

These corrections are summarized in the table below:

```
Cal          UDOT               Adjusted
Year         HPMS               AADT
             AADT               VMT
             VMT                (from TDM)

2008         2,556,007          2,428,627
2009         2,357,550          2,359,077
2014         not available      3,156,282
2017          "    "            3,451,167
2019          "    "            3,647,756
2020          "    "            3,746,051
```

Winter weekday and winter weekend day traffic for projection years was developed in a similar manner. The CMPO MOVES MIX displays winter weekday and winter weekend day VMT for all calendar years from 2008 through 2050 inclusive. The calculation incorporates the AADT VMT and weekday/weekend day conversion factors obtained from the Cache MPO Travel Demand Model, and the January (winter) conversion factors supplied by UDOT.

Cache MPO obtained historical HPMS AADT VMT for calendar years 2002 through 2009. The 2010 HPMS AADT VMT is estimated, and the final AADT VMT obtained after adjustment of HPMS VMT by the Travel Demand Model, resulting in the final AADT VMT.

Conversion factors from AADT to AWKDT for Cache County were obtained from the CMPO Travel demand Model. Winter (January) factors were provided by UDOT:

Cal Year	Road Type	Road Type No.	AADT VMT (from TDM)	AADT-to AWKDT	AWKDT	Winter Factor	Win AWKDT
2008	Rural Restricted (Fwy)	2	0	0.9991	0	0.8511	0
"	Rural Unrestricted (Art)	3	500,755	0.9926	497,049	0.8097	402,469
"	Urban Restricted (Fwy)	4	0	1.0957	0	0.9337	0
"	Urban Unrestricted (Art)	5	983,381	1.1150	1,096,470	0.9311	1,020,922
"	Rural Local	32	35,687	0.9926	35,423	0.8711	30,856
"	Urban Local	52	908,804	1.1150	1,013,316	0.9506	963,229
2008	SUM		2,428,627		2,642,259		2,417,476

WFRC Method

WFRC uses data from the travel demand model to prepare VMT by vehicle type distribution data required for running the MOVES model. WFRC has prepared a travel model program, named TDM2MOVES, to generate vehicle activity input files required for running the MOVES model. This program tallies VMT by facility type (freeway, ramp, arterial, and local) for each county. Adjustments are made to these totals for winter and summer traffic conditions as well as for HPMS correction factors. The TDM2MOVES program also incorporates VMT fractions by vehicle type data for each facility type and county as described in the section below. The VMT by facility values are then multiplied by the VMT by vehicle type fractions to obtain the VMT by vehicle type. The VMT for each of the MOVES vehicle types is then totaled for all facilities.

The WFRC travel demand model was run for the years 2007, 2009, 2016, and 2020. To prepare MOVES input files for SIP analysis years 2010 and 2015, it was necessary interpolate VMT by vehicle type data from the modeled years closest to the desired SIP analysis year.

VMT forecasts using the travel demand model are highly dependent on socio-economic data, primarily population and employment projections. These socio-economic forecasts are revised on a regular basis in response to the most recent trends in population growth and economic activity. For this reason, future VMT forecasts are subject to some margin of error or uncertainty.

There is also an ongoing effort to improve travel demand modeling practice. These refinements in travel demand model practice can also lead to variations in the forecast of VMT for future years.

To deal with this margin of error in VMT forecasts, the WFRC added a margin of error of 10% to the VMT forecasts for the year 2020. Other analysis years (2009-2019) also applied a margin of error on a sliding scale from 0% in 2008 to the 10% value used for 2020. This same margin of error was also applied to the vehicle population profile in order to keep the vehicle starts and vehicle trip length relationship consistent within the MOVES model.

(5) Vehicle Type VMT Mix

UDAQ Method

UDAQ developed Vehicle Type VMT Mix data for CMPO, MAG, WFRC and the ten rural counties.

"Vehicle Type VMT" is often referred to as "travel fraction" or "VMT fraction", indicating how VMT is distributed among the vehicle types.

For interstate and arterial facilities, UDAQ obtained raw VMT travel fractions for ten FHWA vehicle classes grouped by Gross Vehicle Weight Rating (GVWR) ranges from the UDOT Division of Systems Planning and Programming. The travel fractions were obtained by county from automated pneumatic counters that detect axle spacing and "weigh-in motion" (WIM) counters placed on arterials and interstates.

Since there are no counters on local roads, the UDAQ used travel fractions for LDVs and HDVs from the MPOs' local road surveys for urban counties.

The data was converted to MOBILE6 vehicle types and then to MOVES vehicle (source) types. The base year for these data was 2008.

VMT on each road type was divided among ten vehicle classes by Gross Vehicle Weight Rating (GVWR). The ten vehicle classes used by UDOT are as follows:

```
Vehicle                GVWR Range(lb)

LDV                    ≤ 6,000
LDV                      6,000 < GVWR ≤  8,500
HDV                      8,500 < GVWR ≤ 10,000
HDV                     10,000 < GVWR ≤ 14,000
HDV                     14,000 < GVWR ≤ 16,000
HDV                     16,000 < GVWR ≤ 19,500
HDV                     19,500 < GVWR ≤ 26,000
HDV                     26,000 < GVWR ≤ 33,000
HDV                     33,000 < GVWR ≤ 60,000
HDV                             GVWR > 60,000
```

Individual VMT values for the above ten vehicle types on each road type were converted to fractions. The EPA default VMT fractions for calendar year 2008 were then used to expand the fractions for ten vehicles to the sixteen vehicle types in MOBILE6.

MOBILE6 vehicle types were grouped into the six MOVES gross vehicle types by decile (i.e., 10 = motorcycle, 20 = passenger car, 30 = passenger truck and light commercial truck, 40 = buses, 50 = single-unit haul truck, and 60 = combination truck.).

The final step was to break up the VMT under each decile into fractions for all the MOVES vehicle types under that decile. For example, decile "30" is comprised of passenger truck and light commercial truck. The VMT fractions for these vehicle types were obtained from their respective MOVES default fractions. In the same way, MOVES default fractions for vehicle types in each respective "decile" were used to obtain the final VMT fractions for the thirteen vehicle types in MOVES.

To obtain VMT fractions for other calendar years (2015), the annual percent change in the MOVES default VMT fractions by calendar year was used to grow the mix. The resulting VMT fractions were normalized to a sum of exactly 1.0000.

MOVES default VMT fractions for projection years were obtained by performing a special MOVES run. The following GUI selection inputs were used:

Settings:	Configure MOVES Default Database: movesdb20100830	
Description:	Contains the name of all the counties modeled.	
Scale:	Domain/Scale: National	
	Calculation Type: Inventory	
Time Span:	Time Aggregation Level: Month	
	Years: 1990, 1999-2050	
	Months: January	
	Days: Weekday	
	Hours: 24	
Geographic Bounds: States: Utah		

Counties: All 17 counties in the Utah PM 2.5 SIP modeling domain

Vehicles/Equipment:	On-road Vehicle Equipment	Fuels: Gasoline and Diesel
		All vehicle gasoline and diesel fuel combinations
Road Type:	Off-Network	
	Rural Restricted Access	
	Rural Unrestricted Access	
	Urban Restricted Access	
	Urban Unrestricted Access	
Pollutants:	Total Energy Consumption	
Output/General	Units:	Grams, Joules, Miles

Output   Activity: Distance Traveled

Output/Output
Emissions Detail   Always: Hour and County

On-road: Road Type and Source Use Type
Advanced   Save Data for the following Masterloop Components:
Performance Features:

                                 Total Activity Generator (TAG)
                                 Copy Saved Generator Data
Database: VMTgenTAG

WFRC Method

VMT fraction data is used in the WFRC TDM2MOVES program to allocate VMT by vehicle type as required by the MOVES program.

(6) Road Type Distribution

For the ten rural counties modeled by UDAQ, road type distribution data is inherent in HPMS AADT VMT supplied by Utah Department of Transportation. MAG and WFRC developed their own road type distribution data from their respective Travel Demand Models. Cache County MPO and UDAQ developed road type distribution for Cache County.

Details of VMT development is already discussed in section (4) above.

In brief, the starting point to obtain VMT by road type distribution is HPMS AADT VMT. HPMS groups VMT into twelve functional classes. Not all counties show VMT under each of the twelve HPMS functional classes. For example, Cache County does not have any interstates. UDOT HPMS VMT was organized by UDAQ according to the following MOVES road type ID's:

```
Modified MOVES              Road Type ID    UDOT HPMS Categories
Road Type IDs

Rural Restricted              2             Rural Interstate (01)
(Interstate and Fwy)                        Rural Other Principal Arterial (02)


Rural Unrestricted            3             Rural Major Collector (07)
(Arterial)                                  Rural Minor Collector (08)
                                            Rural Minor Arterial (06)
Urban Restricted
(Interstate and Fwy)          4             Urban Interstate (11)
                                            Urban Freeway and Expressway (12)

Urban Unrestricted            5             Urban Other Principal Arterial (14)
                                            Urban Minor Arterial (16)
                                            Urban Collector (17)

Rural Local                   32            Rural Local (09)

Urban Local                   52            Urban Local (19)
```

WFRC Method

WFRC uses data from the travel demand model to prepare the road type distribution data required for running the MOVES model. The road type distribution data prepared by WFRC uses the same seven road type descriptions as defined above for the DAQ procedure. For the urbanized WFRC planning area, WFRC treats all VMT reported in the travel demand model as "urban" VMT.

WFRC has prepared a travel model program, named TDM2MOVES, to generate the vehicle activity input files required for running the MOVES model. This program includes adjustment factors to correct travel model values for VMT to weekday HPMS values for VMT as reported by the Utah Department of Transportation. The TDM2MOVES program also includes adjustment factors for winter and summer variations in vehicle activity.
The WFRC travel demand model was run for the years 2007, 2009, 2016, and 2020. To prepare MOVES input files for SIP analysis years 2010 and 2015, it was necessary use road type distribution files from the modeled year closest to the desired SIP analysis year.

(7) Average Speed Distribution

UDAQ developed average speed distribution data for the ten rural counties it modeled. CMPO, MAG and WFRC developed their own average speed distribution data.

UDAQ Method

The "Easy Mobile Inventory Tool" (EMIT) created by FHWA was used to compute MOBILE6 average speeds for restricted and unrestricted road types. EMIT creates a MOBILE6 speed input file utilizing the Highway Capacity Method to determine rural speeds based on HPMS data. This tool is important for estimating speeds in rural areas that do not have a travel demand model. UDOT Division of Systems Planning and Programming provided HPMS Rural County lane miles for 2008. The rural HPMS data is sorted by the following MOBILE6 road types for input into the FHWA Easy Mobile Inventory Tool (EMIT):

```
                 HPMS                      MOBILE6 Road Types
    Rural Interstate (01)          Interstate
    Rural Other Principal Arterial  Other Principal
    (02)                            Arterial
    Rural Minor Arterial (06)       Minor Arterial
    Rural Major Collector (07)      Major Collector
    Rural Minor Collector (08)      Minor Collector
    Rural Local (09)                Local
    Urban Interstate (11)           Interstate
    Urban Freeway and Expressway (12) Other Freeway
    Urban Other Principal Arterial  Other Principal
    (14)                            Arterial
    Urban Minor Arterial (16)       Minor Arterial
    Urban Collector (17)            Major Collector
    Urban Local (19)                Local
```

UDAQ created a modified database which added rural and urban local roads. Speeds for all local roads were set to 12.9 mph as in MOBILE6. MOBILE6 SPEEDVMT distributions were converted to MOVES average speed distributions using the EPA Average Speed Converter MOBILE6.xls tool.

CMPO Method

Cache MPO obtained average speed distributions from its Travel Demand Model. The TDM analyzes over 3,290 separate traffic segments called "links" that together comprise the network of roads in Cache County.
Each link is assigned, for each of the four major time periods during the day (AM peak, midday, PM peak and nighttime), an average speed, an increment of VMT and an increment of VHT (vehicle hours traveled).

A specific number of links are assigned to each of the UDOT HPMS functional classes (road types, e.g., rural local, urban local, rural minor arterial, urban minor arterial, and so on).

In effect, average speeds, VMT and VHT for each of the functional classes are combined to obtain average speed, VMT and VHT for rural arterials, urban arterials, rural local roads and urban local roads. (There are no interstates in Cache County).

The average speeds, VMT and VHT are converted to MOBILE6 VMT fractions for each of 16 speed ranges such that the VMT fractions represent the 24-hour speed profile of arterials and local roads weighted by VMT.

This file is known in MOBILE6 as the "Speedvmt" file. Using an EPA-provided converter tool, the M6 Speedvmt file is converted to the MOVES "averagespeeddistribution" file. Recall that the M6 speed file includes fourteen speed bins, but the MOVES file includes 16 speed bins. Lastly, the MOVES averagespeeddistribution file is imported into MOVES2010a as one of the input tables, or CDMs.

WFRC Method

WFRC uses data from the travel demand model to prepare the average speed distribution data required for running the MOVES model. The average speed distribution data prepared by WFRC uses the same seven road type descriptions as defined above for the WFRC road type distribution procedure. For the urbanized WFRC planning area, WFRC treats all VMT reported in the travel demand model as "urban" VMT.

WFRC has prepared a travel model program, named TDM2MOVES, to generate the vehicle activity input files required for running the MOVES model. This program does not distinguish speed variations by season as this detail is beyond the scope of the travel demand model. The travel demand model is calibrated to samples of actual highway speed data; the resulting speed profiles are treated as representative of actual travel speeds without further post-model adjustments for vehicle speeds.

The WFRC travel demand model was run for the years 2007, 2009, 2016, and 2020. To prepare MOVES input files for SIP analysis years 2010 and 2015, it was necessary use average speed distribution files from the modeled year closest to the desired SIP analysis year.

(8) Ramp Fractions

UDAQ used the MOVES default ramp fraction of 8% for rural counties that have urban and rural freeways. The default was used because no ramps exist in the HPMS system. CMPO, MAG and WFRC developed their own ramp fraction data.

CMPO Method

There are no interstates or ramps in Cache County.

WFRC Method

WFRC uses data from the travel demand model to prepare the ramp fraction data required for running the MOVES model. The ramp fraction is calculated as:

Ramp Fraction = rampVHT / (rampVHT + freewayVHT)

where VHT represents vehicle hours traveled.

WFRC has prepared a travel model program, named TDM2MOVES, to generate the vehicle activity input files required for running the MOVES model.

The WFRC travel demand model was run for the years 2007, 2009, 2016, and 2020. To prepare MOVES input files for SIP analysis years 2010 and 2015, it was necessary use ramp fraction files from the modeled year closest to the desired SIP analysis year.

(9) DayVMTFraction

UDAQ developed Day VMT Fractions for all counties. CMPO, MAG and WFRC used the same fractions.

UDAQ Method

UDAQ exported the default fractions and replaced each value with a "1". The purpose of this is to allow MOVES to model a single day instead of a month, season or year. In the County Data Manager, this file must have day VMT fractions set to "1" for the corresponding month and day being modeled.

sourceTypeID	monthID	roadTypeID	dayID	dayVMTFraction
21	1	1	5	1
21	1	2	5	1
21	1	3	5	1
21	1	4	5	1
21	1	5	5	1
21	1	32	5	1
21	1	52	5	1

etc.

(10) <u>Fuel Type ID</u>

Fuel type ID, fuel formulations and fuel supply were supplied by Utah Petroleum Association (UPA). Gasoline used in Utah was virtually 100% conventional in 2008, and was virtually 100% E-10 beginning around April 2010. CMPO, MAG, WFRC and UDAQ used the fuel formulations supplied by UPA.

(a) <u>Fuel Supply</u>

The table "fuel supply" (in the MOVES default database) is organized by county, calendar year and month.

UDAQ used the MOVES default fuel supply data for diesel fuel, and modified the gasoline portion according to the fuel formulations supplied by UPA. Discussions with UPA found that gasoline produced by the local refineries in Utah have somewhat different fuel formulations that those shown the MOVES default database "moves20100830".

UDAQ obtained fuel formulations from UPA for calendar years 2010 and beyond. A copy of the MOVES default database was made and renamed "UTAH_CDM". UPA fuel formulations for the above years in each of the seventeen counties replaced the MOVES defaults as shown below.

Utah Petroleum Association gasoline fuel formulations are shown for calendar year 2010:

Cal Year	County	FIPs	Fuel Formulation	January RVP (psi)	E-10 (vol %)	Sulfur Content (ppm)	Benzene (%)	Aromatics (%)
2010	All	49057		13.35	10.0	30.84	0.91	15.31

(11) <u>Hour VMT Fraction</u>

MAG, WFRC and UDAQ used the MOVES default hour VMT fractions. Cache MPO developed its own hour VMT fractions from its Travel Demand Model.

(12) <u>I/M Coverage</u> : Davis, Salt Lake, Utah, Weber, and Cache Counties

I/M inputs were developed by CMPO and UDAQ for Cache County. MAG and WFRC

developed their I/M inputs with assistance from UDAQ, which are described in the CDM.

Davis, Salt Lake, Utah, Weber I/M program:

Calendar Year	Light-Duty Gasoline Vehicles (< 8,500 lb GVWR)	Model Years	Test Procedure	Frequency	Note
2010	LDGV LDGT 1 LDGT 2	1968 - 1995 " "	Two-speed Idle	Annual	
	LDGV LDGT 1 LDGT 2	1996 - 2004 " "	OBDII Exhaust & Evaporative	Annual	
	LDGV LDGT 1 LDGT 2	2005 - 2010 " "	OBDII Exhaust & Evaporative	Biennial	Biennial 6 MY
2015	LDGV LDGT 1 LDGT 2	1968 - 1995 " "	Two-speed Idle	Annual	
	LDGV LDGT 1 LDGT 2	1996 - 2009 " "	OBDII Exhaust & Evaporative	Annual	
	LDGV LDGT 1 LDGT 2	2010 - 2013 " "	OBDII Exhaust & Evaporative	Biennial	Exempt 1st 2 MY Biennial 4 MY

Cache County I/M Program:

Calendar Year	Light-Duty Gasoline Vehicles (< 8,500 lb GVWR)	Model Years	Test Procedure	Frequency	Exempt Vehicles
2015	LDGV LDGT 1 LDGT 2	1968 - 1995 " "	Two-speed Idle	Biennial	
	LDGV LDGT 1 LDGT 2	1996 - newer " "	OBDII Exhaust & Evaporative	Biennial	Exempt 1st 6 MY

(13) <u>MonthVMTFraction</u>

The default database contains different fractions for each month, to be used when an annual inventory is created. UDAQ set all fractions for the base year and projection years to "January", or "1". This is required in order to model single days with MOVES.   CMPO, MAG, WFRC and UDAQ used the same "monthVMT fraction" in their modeling.

ix. Model Outputs

For emission inventory purposes, the seventeen counties were assigned to the MPOs and UDAQ as follows:

MPO   Counties

Cache MPO   Cache
Mountainland Association of Governments   Utah
Wasatch Front Regional Council   Box Elder, Davis, Salt Lake, Tooele, Weber
UDAQ   Carbon, Duchesne, Emery, Juab, Millard,
Morgan, Rich, Sanpete, Summit, Wasatch

Working through the MOVES input screen under the menu item "Output" (on the left-hand side of the screen), the sub-menu item "General Output" allows the user to choose the desired units and other output data parameters. Units used by UDAQ appear in bold font below:

(1) Units (Output)

Mass Units   grams, kilograms, pounds, U.S. Tons
Energy Units   joules, kilojoules, million BTU
Distance Units   kilometers, miles

(2) Activity (Output)

The following data sets may be output:

Distance Traveled
Source Hours
Source Hours Idling
Source Hours Operating
Source Hours Parked
Population
Starts

(3) Output Emissions

Under the menu item "Always", UDAQ chose units that appear in bold font below:

Time   **24-hour day**, Hour, Portion of Week, Month, Year
Location   **County**, Nation, State, Zone
Pollutant   **Y** or N

The menu items "Estimate Uncertainty" and "Number of Iterations" do not function during an actual run.

Output from MOVES can be organized several ways, depending on the user's desired selections on the "Output Emissions" screen. UDAQ selected output by vehicle type (source classification code or SCC), and emission process. SCC identification and vehicle type is defined as follows:

(4) Source Classification Codes   Vehicle Type

220	1001	LDGV
220	1020	LDGT I
220	1040	LDGT II
220	1070	HDGV
220	1080	MC
223	0001	LDDV
223	0060	LDDT
223	0071	HDDV2b ($8,500 < GVWR \leq 10,000$ lb)
223	0072	HDDV3, 4, 5 ($10,000 < GVWR \leq 19,500$ lb)
223	0073	HDDV6, 7 ($19,500 < GVWR \leq 33,000$ lb)
223	0074	HDDV8a ($33,000 < GVWR \leq 60,000$ lb)
"	"	HDDV8b ($> 60,000$ lb)
223	0075	HDDB (school and transit bus)

(5) Road Types

UDAQ modified the MOVES database (20100830) by adding local roads to the road types. Codes assigned to the road types were defined as follows:

Code   Road Type

11	Rural Interstate
13	Rural Arterial
21	Rural Local
23	Urban Interstate
27	Urban Arterial
33	Urban Local

(6) Components of Pollutants

One or more of the following components were used for the various pollutants:

Code   Component

B	brake wear
T	tire wear
X	exhaust
V	evaporative

The workbooks that show the output emissions are found in the Appendix. There is a separate directory for each agency that performed the modeling:

CMPO	= Cache MPO
MAG	= Mountainland Association of Governments
UDAQ	= Utah Division of Air Quality
WFRC	= Wasatch Front Regional Council

(7) <u>Summary Reports</u>

MOVES produces summary reports after program execution. The user chooses the top menu item "Post-Processing" and then chooses "Produce Summary Report". The output can immediately be converted to EXCEL or some other format.

EXCEL workbooks were created for each county by corresponding agency (Cache MPO, MAG, UDAQ and WFRC). Within each county output dataset there is a separate workbook for each calendar year.

MOVES output summary reports are found in the following directory:

PM 2.5 MOVES Files SL P\UDAQ\Output\
PM 2.5 MOVES Files SL P \CMPO\IM\Outputs\
PM 2.5 MOVES Files SL P \CMPO\No IM\Outputs\
PM 2.5 MOVES Files SL P \MAG\Outputs\
PM 2.5 MOVES Files SL P \WFRC\Outputs\
Note: See CDMs above.

Units for emissions shown above are grams per winter weekday. To convert grams per day to tons per year, multiply grams by 907,185 (= 453.59 x 2,000). Distance, or VMT, is in units of winter average weekday traffic (win AWKDT) or winter average weekend day traffic (win AWKNDT).

xi. **Fugitive Dust (PM10 and PM2.5) from Paved Roads (Re-entrained Road Dust)**

Fugitive Dust Emissions

PM10 and PM2.5 fugitive dust from paved roads ("re-entrained road dust") is not modeled by MOVES. Instead, the method from AP-42, Chapter 13, was used.

AP-42, Chapter 13.2, "Introduction to Fugitive Dust Sources", Section 13.2.1, "Paved Roads", has been revised since the November 2006 version. The new final version dated January 2011 was announced in the Federal Register on February 4, 2011.

UDAQ modeled fugitive dust from paved roads using the final January 2011 version.

(1) Constants k and Average Vehicle Weight

Inputs are somewhat different between the models. Inputs common to both methods include the following:

Name of Input	Description	Detail	New Values	
(1) Constants k for PM10 and PM2.5 multiplier			1.0, 0.25 for PM10 and PM2.5 respectively	
(2) Average Vehicle Weight	tons	Interstate	var.	var.
		Arterial	var.	var.
		Local	var.	var. *

*In general, average vehicle weight is highest on interstates and lowest on local roads. In rural counties, average vehicle weight is often a factor of three or four times higher than in large urban counties due to the relatively higher percentage of large trucks in rural areas compared to urban areas with large volumes of commuter traffic.

(2) Silt Loading Factors (SLF)

UDAQ, after discussions with the Interagency Consultation Team, used the recently approved methodology in the latest version of AP-42, Ch 13.2.1 published in the FR January 2011. EPA default silt loading factors (SLF's) were used. The Team determined that the SLF's from an old local study on silt loading conducted in Salt Lake County were of questionable accuracy (see Reference #1).
The EPA default SLF's are shown below, copied from Table 13.2.1-2 of the January 2011 guidance in AP-42:

ADT Category	< 500	500-5,000	5,000-10,000	> 10,000
Ubiquitous Baseline (g/m2)	0.6	0.2	0.06	0.03 0.015 limited access

The workbooks for fugitive dust are found in the Appendix.
MOVES Files SL P\UDAQ\Dust\
Note that the inventories of fugitive dust from paved roads are in units of **tons per year** as requested by UDAQ Technical Analysis Section.

(3) <u>Precipitation</u>

Precipitation inputs were obtained from the UDAQ Technical Analysis Section. Units are "number of hours per day with precipitation greater than 0.01 inch". As precipitation increases, fugitive dust decreases. The precipitation factor (1 - 1.2P/N) is less than or equal to 0 whenever the value of P is 20 or more (hours out of 24). In this case, the EF for dust equals zero. For P = 0, the EF is maximum.

 (4) <u>SMOKE Formats for PM2.5 and PM10 Fugitive Dust Inventories</u>

Lastly, SMOKE formats for fugitive dust inventories were prepared by UDAQ. These formats contain only outputs with the following descriptors:

1. County FIPs
2. SCC
3. Pollutant
4. TPY

(xi) Appendix--Base Year and Projection Years For PM2.5 SIP

Base Year   2010
Projection Years 2015

<u>MOVES Files C SL P</u>

CMPO\File Development
CMPO\IM\CDM\
CMPO\IM\MRS\
CMPO\Outputs\
CMPO\No IM\CDM
CMPO\No IM\MRS
CMPO\No IM\Output

Dust\

File Development\AVFT
File Development\Fuelsupply
File Development\July 20,2011 Temperature Study
File Development\Met Data

MAG\CDM
MAG\File Development
MAG\MRS
MAG\Output

UDAQ\CDM
UDAQ\File Development
UDAQ\MRS
UDAQ\Output

WFRC\CDM
WFRC\File Development
WFRC\MRS
WFRC\Output

(xii) References

The following documents were used as references in creating the on-road mobile source PM2.5 SIP emissions inventories:

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